What is claimed is:

1. A turbine engine component comprising:
   a) a substrate made of a nickel-base or cobalt-base superalloy;
   b) a non-metallic oxide or nitride diffusion barrier layer overlying the substrate; and
   c) a protective coating overlying the barrier layer, the protective coating comprising at least one platinum group metal selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium.

2. The component of claim 1 wherein the diffusion barrier layer is an oxide material.

3. The component of claim 2 wherein the diffusion barrier layer is aluminum oxide or zirconium oxide, or mixtures thereof.

4. The component of claim 3 wherein the diffusion barrier layer has a thickness of from about 0.05 to about 10 microns.

5. The component of claim 1 wherein the diffusion barrier layer is a thermally grown oxide material.

6. The component of claim 1 wherein the protective coating comprises at least two metals selected from the group consisting of platinum, palladium, rhodium, ruthenium, and iridium.

7. The component of claim 6 wherein the protective coating comprises at least about 50% by weight of platinum or rhodium, or mixtures thereof, and has a thickness of from about 10 to about 60 microns.

8. A turbine engine component comprising:
   a) a substrate made of a nickel-base or cobalt-base superalloy;
   b) a non-metallic oxide or nitride diffusion barrier layer overlying the substrate; and
   c) a protective coating overlying the barrier layer, the protective coating comprising at least one platinum group metal selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium; and

d) a ceramic thermal barrier coating overlying the protective coating.

9. The component of claim 8 wherein the diffusion barrier layer is aluminum oxide or zirconium oxide, or mixtures thereof.

10. The component of claim 9 wherein the diffusion barrier layer has a thickness of from about 0.05 to about 10 microns.

11. The component of claim 10 wherein the diffusion barrier layer has a thickness of from about 0.5 to about 5 microns.

12. The component of claim 10 wherein the protective coating comprises at least about 50% by weight of platinum or rhodium, or mixtures thereof.

13. The component of claim 12 wherein the protective coating comprises at least two metals selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium.

14. A method for forming a protective coating system on a turbine engine component, the method comprising:

a) providing a substrate made of a nickel-base or cobalt-base superalloy;

b) forming a non-metallic oxide or nitride diffusion barrier layer on the substrate; and

c) depositing a protective coating comprising at least one platinum group metal selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium on the barrier layer.

15. The method of claim 14 wherein the diffusion barrier layer is a thermally grown oxide material.

16. The method of claim 15 wherein the thermally grown oxide layer is promoted by depositing a layer of aluminum, aluminide, chromide, or platinum group metal on the substrate, followed by an oxidation step.

17. The method of claim 16 wherein the diffusion barrier layer is aluminum oxide having a thickness of from about 0.05 to about 10 microns.

18. The method of claim 14 wherein the substrate surface is roughened by grit blasting, etching, peening, grooving, or combinations thereof, prior to forming the diffusion barrier layer by a low pressure plasma spray, air plasma spray or high velocity oxy-fuel process.

19. The method of claim 14 wherein the diffusion barrier layer is aluminum oxide having a thickness of from about 0.5 to about 5 microns.

20. The method of claim 19 wherein the protective coating has a thickness of from about 10 to about 60 microns.

21. The method of claim 19 wherein the protective coating comprises at least about 50% by weight of platinum or rhodium, or mixtures thereof.

22. The method of claim 21 wherein the protective coating comprises at least two metals selected from the group consisting of platinum, palladium, rhodium, ruthenium, and iridium.

23. The method of claim 22 wherein the platinum group metals are sequentially deposited.

24. The method of claim 14 wherein the platinum group metal is deposited using an electroplating step.

25. The method of claim 14 wherein the platinum group metal is deposited by ion plasma deposition.

26. The method of claim 14 wherein the protective coating is heat treated at a temperature of from about 900°C to about 1200°C for from about 1 to about 8 hours.

27. A method for forming a protective coating system on a turbine engine component, the method comprising:
    a) providing a substrate made of a nickel-base or cobalt-base superalloy;
    b) forming a non-metallic oxide or nitride diffusion barrier layer on the substrate;
    c) depositing a protective coating comprising at least one platinum group metal selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium on the barrier layer; and
    d) forming a ceramic thermal barrier coating over the protective coating.

28. The method of claim 27 wherein the diffusion barrier layer is a thermally grown oxide material.

29. The method of claim 28 wherein the thermally grown oxide layer is promoted by depositing a layer of aluminum, aluminide, chromide, or platinum group metal on the substrate, followed by an oxidation step.

30. The method of claim 27 wherein the diffusion barrier layer is aluminum oxide having a thickness of from about 0.05 to about 10 microns.

31. The method of claim 30 wherein the protective coating comprises at least two metals selected from the group consisting of platinum, palladium, rhodium, ruthenium and iridium.

32. The method of claim 31 wherein the protective coating has a thickness of from about 10 to about 60 microns, and comprises at least about 50% by weight of platinum or rhodium, or mixtures thereof.